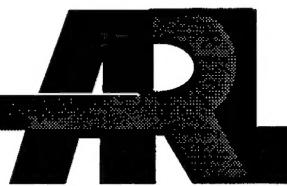ARMY RESEARCH LABORATORY

Skill Level 10 Navigational Skills:
An Examination of Tactical Unmanned
Vehicle (TUV) Soldier-Marine Capabilities

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Skill Level 10 Navigational Skills: An Examination of Tactical Unmanned Vehicle (TUV) Soldier-Marine Capabilities

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Abstract

An analysis was performed to identify specific skills required to successfully perform mission planning and navigational tasks for the future tactical unmanned vehicle (TUV) and to determine if U.S. Army soldiers and U.S. marines with a beginning skill level of 10 have those skills. This analysis was performed by the Human Research and Engineering Directorate of the U.S. Army Research Laboratory at the request of the Program Manager Unmanned Ground Vehicles/Systems. Military occupational specialties examined included U.S. Army infantryman (11B), cavalry scout (19D), and the Marine Corps rifleman (0300). System-required mission planning (pre-mission) and navigational functions and tasks were identified. Soldier-marine navigational skills were compared to mission planning and navigational tasks. Results of the analysis show that of 70 navigational skills required by the TUV system, 33 are mismatched because of a higher skills requirement, untrained system-specific skills, or a combination of both.

CONTENTS

SKILL LEVEL 10 NAVIGATIONAL SKILLS: AN EXAMINATION OF TACTICAL UNMANNED VEHICLE (TUV) SOLDIER-MARINE CAPABILITIES

PURPOSE

The purpose of this document is to identify specific skills required to successfully perform mission planning and navigational tasks for the future tactical unmanned vehicle (TUV) and to determine if U.S. Army soldiers and U.S. marines with a beginning skill level of 10 have those skills. The Program Manager, Unmanned Ground Vehicles/Systems (PMUGV/S) solicited the Human Research and Engineering Directorate (HRED) of the U.S. Army Research Laboratory (ARL) to assist in performing this task.

The desired TUV system will be built to enable operation, in its entirety, by a skill level 10 U.S. Army soldier or a U.S. marine (soldiers-marines). Specifically, the military occupational specialties (MOSs) for these soldiers-marines will be infantryman (11B), cavalry scout (19D), and the Marine Corps rifleman (0300). The source of this issue is the PMUGV Joint Project Office (JPO) TUV outstanding issues database:

Issue No. 1.116: What tasks are required to perform mission preparation after receipt of orders? and

What tasks are required to perform immediate path planning and higher level navigation?

BACKGROUND

The TUV will be the first fielded unmanned system designed for the removal of soldiers-marines from hostile environments. To date, no prior work has addressed the skills required by soldiers-marines to perform teleoperations tasks. The personnel requirement of this future system is that it be readily usable by all soldier-marine skill levels within the MOS fields identified (USMC 0300, U.S. Army 19D, and U.S. Army 11B). The ability to remotely control (teleoperate) this system will depend mainly upon human factors interface design characteristics. Past unmanned ground system failures have been traced to either inefficient sensor design or to poorly designed control display layout. Some anecdotal evidence of this comes from two sources: the Office of the Secretary of Defense (OSD) demonstation (DEMO) I and the surrogate teleoperated vehicle (STV) operational test. During DEMO I, a demonstration of teleoperated systems technology, it was noted that to maintain proper vehicle control, vehicle operators seldom exceeded 5 mph on secondary roads. The STV operational test had two

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operators working simultaneously, one for vehicle operation and one for navigation. The STV system had little to no usable situational awareness information, and the operators often could not determine where the vehicle was. (The fiber-optic connection to the vehicle was followed to locate the vehicle.) In addition, the STV tipped over more than once, which was attributed to lack of vehicle orientation cues (pitch and roll). The important issue here is to present navigational information in a cohesive, efficient, and useful manner. Mission success is a combination of well-trained soldiers-marines using well-thought-out equipment.

Before continuing, some explanation of both the improved performance research integration tool (IMPRINT) and the SARGE (not an acronym) mission planner is required to understand this document. IMPRINT is described because of its utility in developing function and task networks, which were needed to establish the tasks required of the operator. The SARGE mission planner is described because of its future incorporation into the TUV system.

IMPRINT

IMPRINT is a Windows™-based software application for conducting front end analyses (FEAs) in support of materiel acquisition programs or upgrades. IMPRINT is a multi-dimensioned analysis tool that can be used to conduct a variety of different types of studies. It can be used to assess system (including human) performance during a variety of conditions (e.g., with and without mission-oriented protective posture [MOPP]). Physical and cognitive workload for the system's crew can be estimated. IMPRINT can also be used to assess maintenance policies and procedures (e.g., does adding another shift increase operational availability?). Another use is to assess manpower, personnel, and training requirements for weapon system alternatives being considered.

IMPRINT provides an integrated environment to store and retrieve a variety of data sets that are pertinent to a system. For example, task data, personnel data, equipment data, and force structure data can be combined and integrated using IMPRINT. Additionally, IMPRINT has extensive data libraries and reference data sets that can be pulled directly into an analysis, avoiding data entry and saving user time. Users can also move data easily between IMPRINT and other Windows™-based applications. This is the case for this analysis; a complex function and task network was developed in IMPRINT for the purpose of understanding work functions and task breakdown structures. Task information developed in IMPRINT was moved into the Excel™ spreadsheet environment for this analysis.

SARGE

SARGE is a small all-terrain vehicle that has been fitted with teleoperation-capable hardware and software. The mission-planning capability of the TUV will be adapted from the SARGE. SARGE is a mobile platform that is controlled by an operator at an operator control unit (OCU). This OCU has four basic functions: (a) driving, (b) reconnaissance, (c) navigation, and (d) mission planning. The navigational display lets the operator know where the mobile base unit (MBU) or teleoperated vehicle is in relation to the OCU and friendly or enemy units. The mission-planning display lets the operator plan OCU position, final MBU position, and waypoint placement. Mission planning also includes the use of radio frequency (RF) and line-of-sight (LOS) analysis to plan the optimum MBU route. The SARGE mission planner and navigational displays reside in a separate control-display configuration. This interface exists on a small laptop computer that uses a map display, pull-down menus, and a mouse control in a common personal computer operating system. The SARGE mission planner will be adapted to the future TUV system.

METHODOLOGY

A summary of the methodology used for this analysis is a comparison of tasks required to navigate the TUV and the skills that soldiers-marines have at the skill 10 level. Data sources were sought that described the basic and MOS skills that soldiers-marines have. The appropriate skills were identified in those sources. The tasks from the overall TUV task list were reviewed to identify those tasks relating to navigation. Finally, those tasks were compared to the skills of the soldiers-marines.

Data Sources

Data sources used for this effort are listed in the References section of this report.

Soldier-Marine Navigational Skills Identified

Tasks relating to mission planning and navigation were identified by the author of this report. Soldier-marine common tasks and basic MOS skill requirements are listed in Appendix A.

Tasks Identified

Mission planning (pre-mission) and navigational functions and tasks are listed in Appendix B, Columns 1 through 4. ARL developed a detailed TUV operations task network in

IMPRINT, based on functions of the TUV system. The functions of the TUV system were adapted from a systems engineering functional flow block diagram developed at PMUGV/S.

The IMPRINT model was assembled for assessing soldier-marine workload under various TUV operations and maintenance scenarios. The function and task network for TUV operations and maintenance were developed from collaboration between ARL and PMUGV/S. The task lists have been "cut and pasted" from the IMPRINT task networks.

The mission planning and navigational task lists have been "cleansed" to remove unnecessary or meaningless tasks for the purposes of this analysis. For example, the original task list also includes dummy task nodes and "yes-no" decision points for numerous cognitive choices in the IMPRINT task networks. They were removed for this analysis.

Mission-planning tasks were identified from interviews conducted by PMUGV support personnel with Armored Battalion Scouts (19D), of the 2-69th Armored Battalion at Ft. Benning, Georgia. The content of the interviews concerned the development of a TUV mission plan, based on an operations order (OpOrder) from a battalion-level commander. The mission would include the planning of several legs of a route for the TUV MBU (as listed in task lists) and a vehicle-mounted OCU.

Navigational tasks for driving were formulated by ARL and subsequently approved by PMUGV as a result of an ARL-PMUGV/S effort.

Soldier-Marine Navigational Skills Cross-Walked onto Mission Planning and Navigational Tasks

The tasks affected in the overall function and task list were identified as skill 10 capable (yes,11, no, 12) in Columns 11 and 12 of Appendix B. Column 13 describes in brief format the nature of the conflict with skill level 10 capabilities. The decision of whether skills were compatible with the tasks was made by the author, using the opinion of a subject matter expert (SME), a Major (Inf) at PMUGV/S who has more than several years of experience in the area of unmanned systems.

ANALYSIS RESULTS

Table 1 is a detailed listing of the nature of conflicting tasks identified for TUV mission planning and navigation.

Table 1

Conflicting Tasks and Skills Identified

Task identified	Soldier-marine MOS affected
7.4.3.1.1 Assess Named Area of Interest (NAI) from Operations Order (OpOrder)	*ALL*

Interpreting an OpOrder is a 20-level (E-5 Sergeant) skill. All soldiers-marines at the 20 skill level should be able to perform this task. We recommend that the assessment of the NAI from the OpOrder be performed by a skill level 20 soldier-marine or that this task be trained to skill level 10 soldiers-marines.

Task identified	Soldier-marine MOS affected
7.4.3.1.2 Place MBU Icon in Final Reconnaissance, Surveillance, Target Acquisition (RSTA) Point	*ALL*
7.4.3.1.3 Does MBU LOS and Range Fan Cover the NAI?	*ALL*
7.4.3.1.6 Reposition MBU to Modify the LOS and Range Fan	*ALL*

These tasks are untrained tasks which are unique to the SARGE mission planner and are skills unique to the 19D Cavalry Scout at the 30 skill level. We recommend that these tasks either be performed by skill level 30 19D Cavalry Scouts or that soldiers-marines be trained specifically in the use of the SARGE mission planner.

Task identified	Soldier-marine MOS affected
7.4.3.2.1 Is Fiber-optic a Mission Requirement?	*ALL*

Interpreting an OpOrder is a 20-level (E-5 Sergeant) skill. All soldiers-marines at the 20 skill level should be able to perform this task. We recommend that the assessment of the fiber-optic use from the OpOrder be performed by a skill level 20 soldier-marine or that this task be trained to skill level 10 soldiers-marines.

Task identified	Soldier-marine MOS affected
7.4.3.2.4 Place OCU Icon on OCU Map Display	*ALL*

The task identified is a specific untrained task which is unique to the SARGE mission planner. We recommend that all soldiers-marines be trained specifically in the use of the SARGE mission planner.

Task identified	Soldier-marine MOS affected
7.4.3.2.5 Concealment of OCU OK for LOS RF?	*ALL*
7.4.3.2.6 Is Distance to MBU OK for LOS RF?	*ALL*
7.4.3.2.7 Is Terrain OK for LOS RF?	*ALL*
7.4.3.2.8 Is Enemy Situation OK for LOS RF?	*ALL*
7.4.3.2.9 Is Friendly Situation OK for LOS RF?	*ALL*
7.4.3.2.14 Is Concealment OK for Fiber-optic?	*ALL*
7.4.3.2.15 Is Distance to MBU OK for Fiber-optic?	*ALL*
7.4.3.2.16 Is Terrain OK for Fibre Optic?	*ALL*
7.4.3.2.17 Is Enemy Situation OK for Fiber-optic?	*ALL*
7.4.3.2.18 Is Friendly Situation OK for Fiber-optic?	*ALL*

Interpreting an OpOrder is a 20-level (E-5 Sergeant) skill. All soldiers-marines at the 20 skill level should be able to perform this task. We recommend that the assessment of the OCU concealment, distance to MBU from OCU, terrain, enemy and friendly situations for both LOS RF and fiber-optic operation from the OpOrder be performed by a skill level 20 soldier-marine or that this task be trained to skill level 10 soldiers-marines.

Additionally, the tasks identified are specific untrained tasks which are unique to the SARGE mission planner and the operation of the SARGE vehicle. We recommend that all soldiers-marines be trained specifically in the use of the SARGE mission planner and SARGE vehicle operation modes and limitations.

Table 1 (continued)

7.4.3.3.1   Step MBU back from Present Position   *ALL*
7.4.3.3.2   Have LOS of Previous MBU Location?   *ALL*
7.4.3.3.9   Step OCU Back Behind MBU   *ALL*
     The tasks identified are specific untrained tasks which are unique to the SARGE mission planner. We recommend that all soldiers-marines be trained specifically in the use of the SARGE mission planner.

7.4.3.4.1   Coordinate MBU Movement Forward One Leg   *ALL*
7.4.3.4.2   Coordinate OCU Movement to MBU   *ALL*
     The tasks identified are specific untrained tasks which are unique to the SARGE mission planner. We recommend that all soldiers-marines be trained specifically in the use of the SARGE mission planner.

7.4.3.5.1   Establish Secondary Support Mission to Other Sections   *ALL*
7.4.3.5.2   Create Alternate Route Plan for Alternate Mission   *ALL*
     Interpreting an OpOrder is a 20-level (E-5 Sergeant) skill. All soldiers-marines at the 20 skill level should be able to perform these tasks. We recommend that the assessment of the mission, enemy, troops, and time available from the OpOrder be performed by a skill level 20 soldier-marine or that these tasks be trained to skill level 10 soldiers-marines. Additionally, the task identified is a specific untrained task which is unique to the SARGE mission planner and the operation of the SARGE vehicle. We recommend that all soldiers-marines be trained specifically in the use of the SARGE mission planner and SARGE vehicle operation modes and limitations.

7.4.3.6.2   Evaluate Mission   *ALL*
7.4.3.6.3   Evaluate Enemy   *ALL*
7.4.3.6.4   Evaluate Troops   *ALL*
7.4.3.6.5   Evaluate Time Available   *ALL*
     Interpreting an OpOrder is a 20-level (E-5 Sergeant) skill. All soldiers-marines at the 20 skill level should be able to perform these tasks. We recommend that the assessment of the mission, enemy, troops, and time available from the OpOrder be performed by a skill level 20 soldier-marine or that these tasks be trained to skill level 10 soldiers-marines.

7.4.3.6.14   Estimate Average Speed Over Route   *ALL*
     The task identified is a specific untrained task which is unique to the SARGE mission planner and the operation of the SARGE vehicle. We recommend that all soldiers-marines be trained specifically in the use of the SARGE mission planner and SARGE vehicle operation modes and limitations.

7.4.3.7.1   Collect Coordinated Mission Plans from Sections   *ALL*
7.4.3.7.2   Send Platoon Mission Plan to Battalion   *ALL*
     Interpreting an OpOrder is a 20-level (E-5 Sergeant) skill. All soldiers-marines at the 11B Infantryman and 19D Cavalry Scout 20 skill level should be able to perform these tasks. We recommend that the assessment of the mission, enemy, troops, and time available from the OpOrder be performed by a skill level 20 soldier-marine or that these tasks be trained to skill level 10 soldiers-marines.

7.5.3.1.4   Navigation Position Correct? (UTM/GPS/Waypoint)   *ALL*
     This task is identified as one that can be performed by all skill level 10 soldiers-marines; however, this task within the TUV operation environment uses navigational aids that will require some training to perform this task in a faster, more efficient manner. We recommend that all operators be trained specifically in the use of the TUV navigational aids, specifically, the heads-up display in the driving view that represents vehicle heading and sensor heading in degrees, the integrated vehicle and sensor icon, and the navigational map screen with the additional integrated vehicle and sensor icon.

CONCLUSIONS

Many tasks are projected to be difficult or impossible for the skill level 10 soldiers-marines of the identified MOSs. There are three reasons: (a) the skill requirement for that generic task was higher than skill level 10, (b) the tasks identified are peculiar to a specific type of system operation (SARGE mission planner), or (c) a combination of reasons (a) and (b).

Of the total list of 70 applicable tasks, there were 33 task and skill incompatibilities. Of these 33, eight were skill level mismatches. These task mismatches were attributed to either the requirement for a skill level 20 for five cases and skill level 30 for three cases. Nine tasks were incompatible because of specific system requirements. Eight tasks were related to the SARGE mission planner and one was attributable to a general TUV task. Sixteen of these tasks were incompatible because of a combination of skill level and system-specific requirements. Table 2 provides these data in tabular form.

Table 2

Number of Task and Skill Incompatibilities

Total navigational tasks:	70
Total task and skill mismatches:	33
Skill mismatches (reason a):	8
Skill Level 20 required:	5
Skill Level 30 required:	3
System-specific skills (reason b):	9
SARGE mission planner specific:	8
TUV system specific	1
Combination of reasons a and b:	16

RECOMMENDATIONS

There are three distinct possibilities for improving these skill mismatches:

1. The future TUV operator interface should be designed to accommodate skill level 10 capabilities for all tasks through the use of sound human factors engineering design or when possible and feasible, to re-allocate certain tasks to be automated, eliminating the skill incompatibility altogether. There are design possibilities to either alleviate the more difficult

tasks or to aid the soldier-marine with automated functions so that the soldier-marine with least experience may still teleoperate and perform the TUV mission successfully.

2. Train skill level 10 soldiers-marines to skill level 20 for those tasks identified with additional system-specific task training. This would require that skill level 10 soldiers-marines be trained in the interpretation and application of an operations order to TUV system operations and capabilities.

3. Alter the skill level 10 requirement for TUV operation to that of skill level 20, with training for system-specific tasks only. The other possibility is changing the criteria for basic TUV operations, to raise the minimum skill level from 10 to 20 or 30, to allow for those navigational skills that are more fully developed in the soldier-marine with more experience.

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APPENDIX A

U.S. ARMY AND U.S. MARINE CORPS NAVIGATIONAL TASKS

U.S. ARMY AND U.S. MARINE CORPS NAVIGATIONAL TASKS

U.S. Army
STP 21-1-SMCT, Soldier's Manual of Common Tasks, Skill Level 1

071-329-1001 - Identify terrain features on a map. Identify major terrain features: hill, ridge, valley, saddle, and depression. Identify minor terrain features: draw, spur, cliff

071-329-1002 - Determine the grid coordinates of a point on a military map using the military grid reference system: Determine the six-digit grid coordinates for a point on a map with a 100 meter tolerance (grid coordinates must contain the correct two-letter 100,000-meter-square identifier. Determine the eight-digit grid coordinates for a point on a map with a 50 meter tolerance (grid coordinates must contain the correct two-letter 100,000-meter-square identifier.

071-329-1003 - Determine a magnetic azimuth using a compass: Determine the correct magnetic azimuth to a designated point, within 3 degrees using the compass-to-cheek method or within 10 degrees using the centerhold method.

071-329-1018 - Determine direction using field-expedient methods: Determine direction using the three field-expedient methods: stick or branch and two stones or a wrist watch, or at night given a clear view of the big dipper.

071-329-1012 - Orient a map to the ground by map-terrain association: Orient a map to North within 30 degrees.

071-329-1005 - Determine a location on the ground by terrain association: Determine the six-digit coordinates of your location to within 100 meters.

071-329-1008 - Measure distance on a map. Determine the straight line distance, in meters, between two points to within 100 meters. Determine the road (curved-line) distance, in meters, between two points to within 200 meters.

071-329-1006 - Navigate from one point on the ground to another point, dismounted: Move on foot to desigated points at a rate of 3,000 meters in an hour.

AR 611-201, Jun 1991
Military Occupational Specialty (MOS) 19D, Cavalry Scout
10 - Locates points on a map, distinguishes topographic features, and uses compass

10 - Uses maps, map symbols and overlays

10 - Navigates on ground from point to point

20 - Prepares, files, and distributes maps and overlays.

30 - Evaluates routes, assembly area, and positioning for mounted combat operations.

Military Occupational Specialty (MOS) 11B, Infantryman
10 - Performs land navigation functions by terrain association.

20 - Evaluates terrain and weapon emplacements.

20 - Records operaqtional information on maps.

20 - Reads and interprets maps and aerial photos, reproduces, distributes and files operations, intelligence, administrative and unit training documents, orders and publications.

U.S. Marine Corps Navigation Tasks Identified:

Marine Battle Skills Training (MBST) Handbook, Book 2 PVT-LCPL, Individual Combat Basic Tasks, January 1993

PVTX.18.1 - Perform Basic Map Reading: The Marine must correctly identify the five colors of a map and what each color represents; accurately determine the six-digit grid coordinate of a specified point on a map to within +/- 100 meters; accurately plot a six-digit coordinate on a map to within +/- 100 meters; correctly identify the following natural features on a map: hill, finger, draw, saddle, ridge, and cliff; correctly identify the following man-made features on a map: church, school, building , road, railroad, bridge, and power lines; correctly measure the straight-line distance between two points on a map to within +/- 100 meters (the two points must be at least 4000 meters apart); and correctly measure the curved line distance between two points on a map to within +/- 200 meters (the two points must be at least 4000 meters apart and must be along a road or other curved linear feature).

PVTX.18.2 - Navigate With a Map Using Terrain Association: The Marine must navigate to the two checkpoints using terrain association.

PVTX.18.3 - Navigate With a Map Using a Compass: The Marine must navigate to the four checkpoints, using a map and compass.

CPLX.18.1 - Orient a Map Using Field Expedient Techniques: The Marine must orient a map using a celestial body.

CPLX.18.2 - Locate an Unknown Point Using Resection: The Marine must locate his position using a two-point resection and a six-digit grid coordinate. He must be within 100 meters of his location. The Marine has five minutes to complete this task.

CPLX.18.3 - Locate an Unknown Point By Intersection: The Marine must determine the location of the unknown object by six-digit grid coordinate to within 100 meters within five minutes using two-point intersection.

CPLX.18.4 - Determine Cardinal Directions by Field Expedient Methods: The Marine must determine the four cardinal directions using a celestial body.

CPLX.18.5 - Navigate Around an Obstacle Using the Box Method: The Marine must navigate around an obstacle during the day and night using the box technique.

CPLX.18.6 - Convert Azimuths: The Marine, provided a map, lensatic compass, a protractor, a pencil, a straight edge, and the six-digit grid coordinates of a starting point and destination.

CPLX.18.7 - Navigate by Dead Reckoning: The Marine must navigate to two checkpoints using dead reckoning techniques for land navigation.

CPLX.18.8 - Determine the Magnetic Azimuth to a Distant Point: The Marine must determine the magnetic azimuth to the distant object to within +/- 2 degrees.

CPLX.18.9 - Determine the Elevation of a Point Using a Map: The Marine must determine the elevation of an object or terrain feature to within plus or minus half the contour interval of the map.

SGTX.18.1 - Navigate During the Day Using Intermediate Techniques: The marine must navigate to four of the checkpoints using the GPS, set up the PLRS manpack user unit, manually perform a self-test on the PLRS, determine the time and date using the PLRS, determine your own location using the PLRS, navigate to the four checkpoints using the PLRS.

SGT.18.2 - Navigate During the Night Using Intermediate Techniques: The marine must navigate to four of the checkpoints using the GPS and navigate to the four checkpoints using the PLRS.

MCO 1510.35C, Individual Training Standards for the Infantry (Enlisted) Occupational Field (OCCFLD) 03

Military Occupational Specialty (MOS) 0300, Common Infantryman

Task 0300.4.1 - Determine the location of a point or object by intersection.
Task 0300.4.2 - Determine the location of a point or object by resection.
Task 03004.3 - Select routes using a map.

Military Occupational Specialty (MOS) 0311, Rifleman

Task 0311.6.9 - Navigate using a Global Positioning System (GPS).

APPENDIX B

NAVIGATIONAL TASK LIST

Table B-1

Navigational Task List

FUNCTIONS			TASKS	Skill 10 Capable?		Type of Skill Mismatch
Top	Mid	Low	Task	Yes	No	
7.4 Mission Planning ****				n/a		
7.5 Conduct Mission				n/a		
7.6 Post-Mission Activities				n/a		
	7.4.1 Receive Orders			n/a		
	7.4.2 Conduct Battle Drills			n/a		
	7.4.3 Develop RS/NBC Survey Plan ****			n/a		
	7.4.4 Perform Mission Rehearsals			n/a		
	7.4.5 Prepare for Transport			n/a		
	7.4.6 Final Checks			n/a		
	7.4.7 Assemble Mission Payload			n/a		
		7.4.3.1 Select Final RSTA Point(s) ****		n/a		
		7.4.3.2 Determine Final Teleoperation Point ****		n/a		
		7.4.3.3 Determine Final Teleoperation Route ****		n/a		
		7.4.3.4 Establish TUV Section Traveling Formations ****		n/a		
		7.4.3.5 Coordinate with Additional Systems ****		n/a		
		7.4.3.6 Prepare Travel Time Estimate ****		n/a		
		7.4.3.7 Deliver Brief Back ****		n/a		
			7.4.3.1.1 Assess Named Areas of Interest (NAI) from OpOrders		X	Skill 20
			7.4.3.1.2 Place MBU Icon in Final RSTA Area of OCU Map Displ		X	Skill 30, SARGE M.P. Specific Tasks
			7.4.3.1.3 Does MBU LOS & Range Fan Cover NAI?		X	Skill 30, SARGE M.P. Specific Tasks
			7.4.3.1.6 Reposition MBU to Modify LOS and Range Fan Coverag		X	Skill 30, SARGE M.P. Specific Tasks
			7.4.3.1.7 Final RSTA Position Established	n/a		
			7.4.3.2.1 Is Fibre Optic Only A Mission Requirement?		X	Skill 20
			7.4.3.2.4 Place OCU Icon on OCU Map Display		X	SARGE M.P. Specific Tasks
			7.4.3.2.5 Concealment OK for LOS RF?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.6 Is Distance to MBU OK for LOS RF?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.7 Is Terrain OK for LOS RF?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.8 Is Enemy Situation OK for LOS RF?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.9 Is Friendly Situation OK for LOS RF?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.14 Is Concealment OK for Fibre Optic?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.15 Is Distance to MBU OK for Fibre Optic?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.16 Is Terrain OK for Fibre Optic?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.17 Is Enemy Situation OK for Fibre Optic?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.18 Is Friendly Situation OK for Fibre Optic?		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.2.24 Re-evaluate Position and Try Again	n/a		

Table B-1

Navigational Task List

FUNCTIONS			TASKS	Skill 10 Capable?		Type of Skill Mismatch
Top	Mid	Low	Task	Yes	No	
			7.4.3.2.21 RF Poistion Established	n/a		
			7.4.3.2.22 Fibre Optic Position Established	n/a		
			7.4.3.2.23 Final Teleoperation Point Established	n/a		
			7.4.3.2.12 OCU Fibre Optic Positioning	n/a		
			7.4.3.3.1 Step MBU Back from Present Position		X	SARGE M.P. Specific Tasks
			7.4.3.3.2 Have LOS of Previous OCU Location?		X	SARGE M.P. Specific Tasks
			7.4.3.3.6 Re-position MBU for Proper LOS		X	SARGE M.P. Specific Tasks
			7.4.3.3.9 Step OCU Back Behind MBU		X	SARGE M.P. Specific Tasks
			7.4.3.4.1 Coordinate MBU Movement Forward 1 Leg		X	SARGE M.P. Specific Tasks
			7.4.3.4.2 Coordinate OCU Movement to MBU		X	SARGE M.P. Specific Tasks
			7.4.3.4.5 Add Another Mission Leg	n/a		
			7.4.3.5.1 Establish Secondary Support Mission(s) to other Se		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.5.2 Create Alternative Route Plan for Alternative Miss		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.6.1 Begin Travel Time Estimate	n/a		
			7.4.3.6.2 Evaluate Mission		X	Skill 20
			7.4.3.6.3 Evaluate Enemy		X	Skill 20
			7.4.3.6.4 Evaluate Troops		X	Skill 20
			7.4.3.6.5 Evaluate Time Available		X	Skill 20
			7.4.3.6.6 Evaluate Terrain	X		
			7.4.3.6.7 Evaluate Natural and Intentional Obstacles	X		
			7.4.3.6.8 Evaluate Terrain Elevations & Slopes	X		
			7.4.3.6.9 Evaluate Possible Roads, Paths & Trails	X		
			7.4.3.6.10 Evaluate Ground Surface (Dirt, Mud, Grass, Snow,	X		
			7.4.3.6.11 Evaluate Foliage (LOS & RF Distances per leg)		X	Skill 20, SARGE M.P. Specific Tasks
			7.4.3.6.12 Terrain Evaluated	n/a		
			7.4.3.6.13 METT Evaluated	n/a		
			7.4.3.6.14 Estimate Average Speed Over Route		X	SARGE M.P. Specific Tasks
			7.4.3.6.15 Travel Time Estimate Complete	n/a		
			7.4.3.7.1 Collect Coordinated Mission Plans from Sections		X	Skill 20
			7.4.3.7.2 Send Platoon Mission Plan to Battalion		X	Skill 20

Table B-1

Navigational Task List

FUNCTIONS			TASKS	Skill 10 Capable?		Type of Skill Mismatch
Top	Mid	Low	Task	Yes	No	
7.4 Mission Planning				n/a		
7.5 Conduct Mission ****				n/a		
7.6 Post-Mission Activities				n/a		
	7.5.1 Move			n/a		
	7.5.2 System Set-up			n/a		
	7.5.3 Unmanned Operation ****			n/a		
	7.5.4 System Shutdown			n/a		
		7.5.3.1 Teleoperate to AO (and Moving NBC Detection) ****		n/a		
		7.5.3.3 RSTA Mission		n/a		
		7.5.3.4 NBC Survey Mission		n/a		
		7.5.3.5 Teleoperate Back to OCU		n/a		
		7.5.3.6 Drive Forward to MBU		n/a		
		7.5.3.7 Mission Complete (dummy)		n/a		
			7.5.3.1.1 Teleoperate to AO (Moving NBC Detection)	n/a		
			7.5.3.1.2 Navigate	n/a		
			7.5.3.1.3 Visually on Course (terrain navigation)?	X		
			7.5.3.1.6 Yes	n/a		
			7.5.3.1.8 Hold Course	X		
			7.5.3.1.11 dummy3	n/a		
			7.5.3.1.12 dummy4	n/a		
			7.5.3.1.13 Communicate/Report System Status	X		
			7.5.3.1.4 Navigation Position Correct (GPS/UTM/Waypoint)?		X	TUV Operation Specific Task
			7.5.3.1.9 Steer Left	X		
			7.5.3.1.10 Steer Right	X		
			7.5.3.1.7 No	n/a		
			7.5.3.1.5 Immediate Path Obstacle-Free?	X		
			7.5.3.1.11 Stop MBU	X		
			7.5.3.1.12 Reverse Until Obstacle Passable	X		
			7.5.3.1.14 Power Vehicle	X		
			7.5.3.1.15 Too Fast?	X		
			7.3.5.1.17 Yes	n/a		
			7.3.5.1.18 Decrease Throttle	X		
			7.5.3.1.21 dummy2	n/a		
			7.5.3.1.19 Increase Brake	X		

Table B-1

Navigational Task List

FUNCTIONS			TASKS	Skill 10 Capable?		
Top	Mid	Low	Task	Yes	No	Type of Skill Mismatch
			7.5.3.1.20 Hold Brake	X		
			7.5.3.1.18 No	n/a		
			7.5.3.1.22 Too Slow?	X		
			7.5.3.1.23 Yes	n/a		
			7.5.3.1.25 Increase Throttle	X		
			7.5.3.1.28 dummy1	n/a		
			7.5.3.1.24 No	n/a		
			7.5.3.1.26 Decrease Throttle	X		
			7.5.3.1.27 Hold Throttle	X		
			7.5.3.1.29 Conduct NBC Monitoring	n/a		
			7.5.3.1.30 Detect NBC Contaminants?	n/a		
			7.5.3.1.31 Yes	n/a		
			7.5.3.1.33 Report NBC Information	n/a		
			7.5.3.1.32 No	n/a		
			7.5.3.1.34 Monitor Vehicle Status	X		
			7.5.3.1.35 Monitor Fuel Level	X		
			7.5.3.1.36 Monitor MBU/OCU Battery Levels	X		
			7.5.3.1.37 Monitor Distance Traveled	X		
			7.5.3.1.38 Monitor Date	X		
			7.5.3.1.39 Monitor Time	X		
			7.5.3.1.40 dummy5	n/a		
			7.5.3.1.41 Monitor Vehicle Orientation	X		
			7.5.3.1.42 Monitor Vehicle Pitch Angle	X		
			7.5.3.1.43 Monitor Vehicle Roll Angle	X		
			7.5.3.1.44 Pitch and Roll Angles Acceptable?	X		
			7.5.3.1.45 Yes	n/a		
			7.5.3.1.46 No	n/a		
			7.5.3.1.51 Hold Course	X		
			7.5.3.1.47 Steer Right	X		
			7.5.3.1.48 Steer Left	X		
			7.5.3.1.49 Stop MBU	X		
			7.5.3.1.50 Reverse Until Pitch and Roll is Acceptable	X		
			7.5.3.1.52 dummy7	n/a		
			Note: n/a denotes that the task or function is not applicable, regardless of MOS identified,			
			an "X" in the "No" column denotes that the task cannot be performed			
			an "X" in the "Yes" column denotes that the task can be performed			

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13. ABSTRACT (Maximum 200 words)

An analysis was performed to identify specific skills required to successfully perform mission planning and navigational tasks for the future tactical unmanned vehicle (TUV) and to determine if U.S. Army soldiers and U.S. marines with a beginning skill level of 10 have those skills. This analysis was performed by the Human Research and Engineering Directorate of the U.S. Army Research Laboratory at the request of the Program Manager Unmanned Ground Vehicles/Systems. Military occupational specialties examined included U.S. Army infantryman (11B), cavalry scout (19D), and the Marine Corps rifleman (0300). System-required mission planning (pre-mission) and navigational functions and tasks were identified. Soldier-marine navigational skills were compared to mission planning and navigational tasks. Results of the analysis show that of 70 navigational skills required by the TUV system, 33 are mismatched because of a higher skills requirement, untrained system-specific skills, or a combination of both.

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